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ELECTRO MAGNETISM AS A MOTIVE POWER.

(Continued from page 100.)

From the preceeding remarks it will be seen that we are of the opinion, that further improvement in the electro magnetic engine depends not so much upon any one grand invention, as upon a thousand minor and apparently unimportant alterations. We are aware that this is contrary to the general opinion, but in justification of ourselves, we point to the history of the steam engine, the printing press, the Jacquard loom, cotton machinery, and in fact, of any important engine at present in use. It is true that some ingenious man may make a single great and valuable improvement, but we have no idea that any particular form of wheel, or disposition of magnets (*where there is no change in the principle of action*) is to prevail to the exclusion of every other one. It is true that a second Watt may do for this, what the first did for the steam engine, but it must be a man who, like Watt, knew well the principles with which he had to deal, and who could lay out in the workshop of his fertile brain, employment for the hands of a thousand ingenious mechanics.

Popular prejudice has done much to retard real improvement in this matter, by attaching undue importance to the mere construction of models or machines. By most persons, the inventors of different engines are looked upon as the founders of the science of electro magnetism, and this opinion, sanctioned by the language of the daily press, has raised to high fame the name of mere constructors of any one of the thousand mechanical applications of the principles pointed out and brought to notice by Ampère Faraday, Henry, Daniels, and a host of others, whose names are almost never thought of in connection with this subject.

It is only by a constant reference to these first principles, that any further progress can be made. Any disposition of parts however complicated, which only perpetuates and magnifies the errors and faults of preceding

machines, may serve to blind and impose upon the ignorant or careless observer, but can never bear the tests which have been proposed, and must therefore be condemned by all prudent and intelligent men.

The best guarantee we can have of the success of electro magnetic machinery, is to find it taken up by men of science, wealth and practical skill, and although it is not often found that these important requisites are united in one person, a very fair equivalent is to be found in a number of persons, each one excelling in some one of the three particulars. Since we have commenced writing these remarks, we have understood that such has already been the case and that we shall soon see what science, wealth, and skill united, can accomplish.

Perhaps we can no where, better than in this place, touch upon a subject of rather delicate nature, but bearing a most important relation to the matter in hand—and which, since we have professed to speak freely, we are bound in candor, to notice. We refer to the articles which from time to time appear in our various journals of professed scientific character, upon the subject of electro magnetism.

We consider it *unfair*, to say the least, that a novice in science should arrogate to himself, directly or indirectly, the credit of what has been done before, and perhaps in a better manner, without in the slightest manner alluding to, or crediting the labors of others. This either involves a wilful concealment of the writers knowledge of what has been done before, or an ignorance of the state of the science. Charitably presuming that the latter is the case, all papers, treating us with a re-discovery of important facts and principles in science, should be accompanied by a statement of the case. and correction of the writer's (supposed) misapprehension.

The effect of the continual re-announcement of discoveries of this character, is to create an idea that an extreme ignorance prevails upon this subject, and the result is, that our labors in this field are unfairly treated abroad, and the just and well merited sarcasm bestowed upon quackery in science, is visited upon our whole scientific community. That this evil prevails in all branches of science, we do not deny, but that electricity, galvanism and magnetism, has been dragged into the service of *humbug* in an unprecedented degree, no one can doubt. The most absurd doctrines are broached, and aided by the ignorance and impudence of persons accidentally endowed with some influence in their own circle, the world is nauseated by enormous doses of humbug and absurdity. We need not particularise, but it is well known that the wholesale endorsement of an entire system of evident nonsense by many public men, and well known characters of scientific? reputation, has created in Europe, a most contemptible opinion of science in this country.

To remedy these evils of no small magnitude indeed, there must first be diffused a more general knowledge of these subjects, which are in fact well adapted to popular comprehension, and for this very reason, the more frequently seized upon by quacks. It would be of incalculable benefit to the

community, if those of our own distinguished philosophers, who have done so much for the advancement of the science of electricity and its various ramifications, would in a popular but carefully prepared treatise on this subject, give to the large portion of our people interested in such matters, the results at which they, and the irbrethren in Europe have arrived. Even our colleges have no good American text book for these branches of science, and nothing of a more popular character is to be found.

From the good effect of a few judicious lectures, we are inclined to think that very much might be done by way of oral instruction and actual illustration from models and apparatus.

Another difficulty is to be found in the indifference, with which many men of talent and theoretical knowledge, are disposed to regard any mechanical application of electro magnetism. Is it not their duty to encourage and direct proper experiment? Can they in any way do more good or apply their own knowledge to better purpose? We are firmly convinced, that men of science can do much in this way, and were they to take the field, quacks would soon leave it.

Having already occupied more of the time of our readers than we had intended, we shall conclude with but a few remarks as to the capabilities of the electro magnetic engine in its improved form. Its chief and peculiar advantage is, that the cost of maintaining it in action, commences and ceases almost instantaneously with the action itself. Unlike animal power, it has to be fed only while it works, and days, weeks and months of inaction involve no other expense than the interest on the cost of the machine. Unlike the steam engine, it needs no time for "firing up"—at a moment's notice it can be brought into full action. The second advantage, consists in its freedom from all danger, for though the same *quantity* of electricity, with greater *intensity*, could give a shock equal to a bolt of lightning, yet as used in the electro magnetic machine, no sort of danger whatever is to be apprehended; neither explosion nor fire can possibly take place. Its freedom from danger and its capability of directly obtaining high velocities, are excellent qualifications for its adaptation to cotton, wollen and silk machinery. No agent is better calculated to supply the place of the hands of man, and where no great power is required, even a small model may answer a very good purpose, and many items of domestic labor could be performed most admirably by such a machine. In our large hotels an electro magnetic engine would be of great service, to raise water, brush shoes, clean knives, raise baggage, &c., would alone be a profitable mode of application.

There can be no doubt that as power is gained, this agent will be on a par with steam, and of course, applicable to all purposes with equal if not greater advantage. But there is one use of electro magnetic machinery, which even in its present rude and unimproved form, is worthy of attention. We refer to domestic manufacture, which is destined to become, ere long, a peculiarity of our nation.

The cultivation of the beet root and mulbery, must inevitably lead to the home manufacture of sugar and silk, and the machinery necessary for both purposes, is capable of great simplification and well calculated for the employment of the females and children of an household, assisted by the power of the engine under consideration. We consider that this view of the subject alone, has a remarkable bearing upon our political economy, and is deserving of further notice. Our object, in the remarks we have hastily thrown together, has been to direct attention to an important subject, and if this end is accomplished, we shall be amply rewarded.

Before concluding, we must again remark that we have spoken in general terms with a single exception, having had no reference to any individual, and must therefore be free from the imputation of being influenced by personal prejudice. If the remarks are capable of application, that remains for individual judgment, we have intended no more than a general view of the subject.

American Locomotive Engines in England.—By the following extract from a Philadelphia paper, it will be seen that our mechaincs have again been complimented by an order from England for locomotive engines. They are ordered from Messrs. Baldwin, Vail and Hufty, whose engines have, under the original firm of M. W. Baldwin & Co., attained so high a celebrity.

When we first began to point out the superiority of American locomotives, we had much prejudice to contend with, and while the accounts of various performances was doubted and even sneered at abroad, the feeling in favor of imported engines was yet strong in this country. Now the tables are turned, and we are sending engines to England.

We shall endeavor to obtain from Messrs. B. V. & H., the particulars of their order and present it to our readers, the mere announcement cannot fail to prove highly flattering, not only to these gentlemen, but to American mechanics in general.

We are informed that Messrs. Baldwin, Vail & Hufty have received by the Great Western, applications from the extensive railroad companies in England, for a supply of locomotive engines. This fact speaks volumes, and is the more gratifying from the fact that the gentlemen of that firm have never taken a single step towards introducing their engines in that country, in any way whatever. The application is the result of the high character their engines have acquired for their superiority and efficiency, in this country. We have no doubt but Messrs. Baldwin, Vail & Hufty will sustain their well earned reputation, and have nothing to fear from a fair competition with the manufacturers of old England.

At Stephenson, Rock Island county, Illinois, on the 22nd of August, in the 30th year of his age, Mr. Amidee Blanc, chief engineer of the Rock River improvements.

It is with emotions of deep regret, that we hear that our friend Mr. Blanc is no more. He had quite recently returned from Europe, laden

with useful information, derived from his own observation and the best published authority, and was about to re-commence upon his duties as chief engineer of the Rock River improvement, for which he had thoroughly prepared himself by the inspection of the most approved French works—when he was thus suddenly cut off.

During his professional career, his services rendered to the New York and Erie railroad company, had rendered him known to many who will regret his premature loss. To a sound and discriminating sense in the field, Mr. B. added an uncommon neatness and accuracy in his closet work. His maps and drawings have always been beautiful and exact. During his visit to Europe he made original drawings of many new, and to us unknown works, and it is a source of regret, that so much valuable information should be lost to the country.

To those who knew Mr. Blanc in private life, the loss is indeed a great one. He was characterised by an uncommon modesty, amiability and suavity of disposition, which won the hearts of all with whom he was associated.

We mourn over the loss of a valuable member of the profession, and still more, over the departure of an honest man and a kind friend.

MEMOIR OF LIEUTENANT COLONEL B. AYCRIGG ON THE SUBJECT OF THE LIGHT HOUSES AT BARFLEUR AND OSTEND.

February 13, 1839. Mr. CUSHMAN, from the Committee on Commerce, reported the following resolution; which was read, and agreed to by the House:

Resolved, That a detailed report and drawings of the light-houses at Barfleur and Ostend, prepared by Lieutenant Colonel B. Aycrigg, one of the chief engineers on the State works of Pennsylvania, be printed for the use of the House.

Memoir on the subject of the light house at Barfleur, and also the light house at Ostend, by Lieutenant Colonel B. Aycrigg, A. B., one of the chief engineers on the State works of Pennsylvania.

The following detailed accounts of the light house at Barfleur, on the northwestern coast of France, and also of that at Ostend, on the coast of Belgium, have been prepared with much care from notes taken on the ground, in the summer of 1837, and now are respectfully presented to Congress, in compliance with the request of one of the members, who is desirous of seeing the improvements introduced into our own system.

To fulfil the promise that the description should be furnished, it was found necessary to make a journey to the light at Barfleur, expressly for the purpose; since the plans could not be obtained in the metropolis, in consequence of the absence of the possessor.

In order that there may be no delay on the grounds of want of information, there has been much time and labor bestowed in reducing the measures from those that were taken to their equivalents, measured from two lines of reference, the one vertical, the other horizontal, passing through the centre of the light. The notes, having been thus much simplified by calculation, will be readily understood in all the details by any one familiar with mechanics, and, consequently, any engineer or other mechanical officer might immediately take charge of the construction of a light-house that

will, in all respects, be essentially the same as that at Barfleur or at Ostend, and, with respect to the peculiarities of the former, agree in the minute details.

Should this communication be the means of introducing the lenticular system into our light houses, the writer will feel himself amply compensated for his trouble, by the reflection that he has been the channel through whom an improvement has been brought to our shores, that may preserve the lives of many a warm hearted mariner or useful citizen on his return to his native land; be useful to the commercial world, gratifying to the philanthropist, and leave little more to be expected, unless chemistry should furnish us at some future day with a substitute for the lamp, that might by its superior brilliancy, penetrate farther into the fog and mist. Even in that case, a better arrangement than the revolving lens could not be made for the purpose of disposing of the light after it is produced.

The details will be given at length in the latter part of this communication. But as these may be uninteresting to many who would wish to have a general knowledge of the arrangement, without the necessity of going over a long list of measures, and perhaps in the end have but little satisfaction, unless somewhat accustomed to mechanics, the following familiar description is given, to supersede the necessity of an examination of the minutiæ.

The lamp has four concentric wicks, the largest having a diameter of 3 1-2 inches. They are raised on cylinders separated, that the air may pass between, and so far above the body of the lamp as not to have the light intercepted in its passage to the lower mirror. These four wicks produce a flame six inches high. The oil is supplied in excess by small pumps worked by machinery in the interior of the lamp, wound up in the same manner as a watch. [This is very common in France.] This lamp, being placed in the centre, is surrounded by 16 lenses, in oblong frames, 34 inches high and 14 1-2 inches wide, standing side by side on one ring, and steadied by another laid on top and screwed fast to the frames: thus forming a hollow cylinder of glass, or rather a 16-sided prism of about 6 feet diameter, and 2 feet 10 inches high around the lamp. Each lens is composed of several separate pieces of glass, the centre piece being a perfect plano-convex lens, having the flat side towards the light. The other pieces are portions of circular prisms concentric with the lens, the back coinciding with the plane surface of the middle lens, and the salient angle towards the centre of the frame. In this manner nearly the same effect is produced as from a lens the entire size of all these pieces taken together; while, being comparatively thin, they are much lighter in use, and at the same time much less difficult, and consequently less expensive in construction.

From the measured convexity of the centre lens and the circular segments, it appears that they are all described from the same centre, midway between the light and the curved surface of the middle lens, and consequently that they have taken the ratio of refraction at 2-3, or the average for crown glass, and have neglected the spherical aberration. This difficulty in single glasses is unavoidable, but can easily be obviated in a compound lens. But, as the laws of optics must necessarily be followed in all future works, it would be lost time to go into an investigation of the proper radii for these segments, since they would be inapplicable with a glass having a different refracting power; and this can only be ascertained by experiment on the material to be used.

The backs of all these pieces of glass being in the same plane, a vertical cross-section through the centre would show a straight line on the side towards the light, and a serrated edge on the opposite, having the salient angles about 1 1-8 inch in advance of the re-enterings.

These 16 lenses being thus secured between two rings, the one above and the other below, the lower ring is supported on 8 bars that curve out around the lower mirrors, and then, curving in again to another ring of the size of the former, and below the mirrors, are carried as diagonals, and terminate on a cog-wheel 26 inches diameter, lying horizontally around the shaft, and supported on 6 wheels that roll around on a shoulder of the shaft, when the clock machinery, set in motion by a weight of 300 pounds, acts upon the cog-wheel around the shaft, and thus every 8 minutes causes one revolution of this wheel, together with the diagonals, uprights, and rings that carry the lenses. The whole is kept central by horizontal friction rollers acting on the outside of the shoulder, below the small wheels. The whole of the moving part is poised upon these small wheels below, and has no other support.

These 16 lenses, thus concentrating the light into as many radii projecting from the lantern, might be compared to a revolving capstan with its arms. Each revolution being completed in 8 minutes, the observer sees one of the radii every half minute.

Inside of this revolving circle of lenses is placed a stationary frame to support the mirrors, leaving one inch play between them. The shape of this interior frame is not unlike a large parrot-cage with an eliptical top, while the lamp would represent the perch in the centre. This is firmly secured to the shaft, the moving frame carrying the lenses being supported on a shoulder below, and the shaft itself secured in an opening in the centre of the stone floor below. Upon this frame is supported a platform at 4 feet below the lamp, and upon this platform the keeper stands when cleaning the glasses or attending the lamp. To get into this interior space, he takes the opportunity when the revoling bars that carry the lenses coincide with the fixed bars that support the mirrors, and enters on the land side below the lenses; the mirrors on that side, both above and below, being omitted, and their place supplied by a reflector near the lamp, to throw this part of the light towards the channel.

To this interior frame are attached two rings of strong wire for each row of mirrors, the one being inside and the other outside of the upright bars; upon these rings the mirrors rest, and are brought to the proper angle by adjusting screws, so as to throw the light in the direction of the horizon.

There are 28 of these mirrors in a circle; the four on the land side between two of the bars being left out. There are four circles below the lenses and seven circles above. Those that are above do not come in the way of any thing connected with the revolving part of the work, but those below extending the same distance with those above, or 4 3-4 inches beyond the outer range of the lenses; the bars supporting the lenses are curved out as before mentioned, in order not to touch when moving around outside of the mirrors. The space between the two is one inch, and there is also an inch clear between the bars and the floor outside, on a level with the bottom of the window.

Immediately below the part described is the sleeping chamber of the keeper; a portion of the interior cylinder having been removed, after the column was completed, for the purpose of making room. A stove-pipe from this place passes up on the land side and comes out at the roof.

In this apartment he rests without apprehension, although near the top of the column, and more than 200 feet above the ground, or rather the rocks, swayed by the blast, as the tall shaft springs to the unobstructed force of the wind, sufficient at times, as the keeper asserted, to throw him forward while leaning carelessly against the window, and quite perceptible

during the visit of the writer; the wind roaring loudly around the lantern although at the surface there appeared nothing more than a strong sailing breeze. Still the column has sustained the most violent storms without the least mark of weakness; and this motion arises, not from a tottering of the fabric, but from the elasticity of the material, although that material be granite.

A description of the building has been printed in pamphlet form, but not being at hand at present, and but few notes having been taken respecting the parts contained in the printed account, the writer cannot enter into this subject; nor is it important for the present, since the form and construction of the building depended upon the particular locality, while the application of the light may be universal.

It will readily be seen that a light of this description cannot be used in a combustible building; for should the keeper neglect to put down the curtains in the morning or evening, when the sun is near the horizon, these powerful burning-glasses would, inevitably, produce a conflagration.

The writer observed, both at Barfleur and at Ostend, that several of the mirrors were materially injured by the sea air tarnishing the silvering, although the backs and sides were covered by a sheet of brass turned up around the edges. This difficulty might be removed by previously giving the backs an air-tight coating of varnish.

Another object to be attended to in such constructions is to keep the window-glass perfect in the range of the principal light. A defect, in this respect, was pointed out by the keeper at Ostend, as the glasses meet on the horizontal line; and although merely laid together without any thing between, still a part of the light is lost, that would not have been as great had the joint been above or below.

To the stranger who visits the Barfleur light, this assemblage of 308 mirrors and 16 large lenses, surrounded by 16 windows of plate glass, more than ten feet high, all polished to the highest degree of perfection, and all concentrated within the small compass of the lantern, presents one of the most brilliant exhibitions that the arts can furnish, especially when in addition to this, he feels the effect of standing 236 feet above the level of the ocean, without anything to prevent his falling out; for the plate glass of the windows is scarcely perceptible, although so strong that the largest sea birds cannot break it, but frequently fall dead by the blow when, flying towards the light, they come with full force against the glass. The stranger on entering from the darkness below, is taken by surprise, and for a while, afraid to move, lest he may touch on one side or the other, and the apparently frail fabric crumble under his hands!

(To be continued.)

PROFITS OF RAILROADS.—It is a remarkable fact that almost every railroad, whether in this country or in Europe, after its construction has been found to pay more than was originally estimated. The Boston Centinel of last Saturday says:

Wednesday last completed a year, since the opening of the railroad from Salem to Boston---and during that time two hundred and eighty thousand paying passengers have gone over the road—two and a half times the number originally estimated. The freight cars were not started till after the passenger cars had been in operation some months. Their earnings will afford a nett profit of ten thousand dollars a year.

THE FIRST ANNUAL REPORT OF THE DIRECTORS OF THE ANNAPOLIS AND ELK RIDGE RAILROAD COMPANY.

(Continued from page 128.)

From all the consideration I have been able to give the subject, I can entertain no doubt that this road will yield a fair return of revenue on its cost. The probability is, that in consequence of the improvements now making to facilitate intercourse between the north and the south, Norfolk will become the point to which nearly all the travel, to and from these great sections of the Union, will concentrate; and that an entire inland communication, by which the dangers of the sea may be avoided, will be established between Charleston and New York. When this is the case, passengers going north will have the choice, on arriving at Norfolk, to proceed in steamboats, either for the Eastern Shore railroad, or Baltimore. When the navigation of the Potomac and Patapsco is closed they will be compelled, except at great expense and peril, to resort to the Eastern Shore railroad, unless the Annapolis and Elk Ridge railroad should be constructed, in which event, those that prefer it will land at Annapolis and thence proceed to Baltimore or Washington, as business or pleasure may dictate. The city of Baltimore would find it a serious evil, to be thrown out of the great thoroughfare of travel and trafic between the north and south; and she most assuredly will be so thrown out, at all times when the Patapsco is closed with ice, unless other means of communication than those now existing are opened. The influence which such a state of things is calculated to exert upon her trade, must be perfectly obvious; as the Southern merchant, if he found Baltimore difficult of access, would at once proceed directly to Philadelphia or New York by other and more easy communications. These evils may, however, be corrected by the construction of the Annapolis and Elk-Ridge railway; and Baltimore may derive, in various ways, as much benefit from this short road, in proportion to its extent and cost, as from her own bold and magnificent works. For, independently of its direct advantage to that city, it will prove a valuable auxiliary to her railroads, by drawing to them a considerable amount of business which, under other circumstances, would find some different channel.

It is in this way that a *system* of internal improvements may yield a handsome revenue, while some of the minor and independent works are regarded as unproductive, at the very time that they act as important tributaries to the main trunks, by adding largely to their revenues. Thus in New York, the Erie Canal is the great thoroughfare and common recipient of the smaller works; and although the lateral canals may not be productive, when the receipts derived directly from them are alone taken into view, yet there can be no question, that when regarded, as they should be, as portions of a common system, they contribute in no small degree to the success of the more important works; and such, it is believed, will be the relation in which the road under consideration will stand towards the great public improvements in the State of Maryland. There can be but little doubt that the travel on this route will be considerable at all times, especially during the sessions of the legislature and of the courts. It has been observed as a general rule, that travel always greatly increases when a railroad is opened, and it is not believed that this work is destined to prove the exception. It has also been found that railways obtain a decided preference over all other means of communication, and there is not, perhaps, a stronger instance of the truth of this proposition than is furnished by the Baltimore and Philadelphia railroads, which, when first projected, were ridiculed as chimerical; but no sooner were they opened for travel, than a large proportion of all the passengers were found to prefer that

route to the steamboat line; and it may be laid down as an universal rule, sanctioned by all experience, that the means by which the passengers may be transported from one given point to another, *in the least time*, will always receive the principal part of the public patronage. The time of travel between Annapolis and Baltimore by steamboat, is about three hours. By the railway, it may be something less than two. The establishment of a Naval Academy or Naval Station at Annapolis, would add much to the travel and transportation on this road.

Another source of revenue will be found in the Patuxent granite quarries, near the Savage Factory, which can no where find so convenient an outlet as Annapolis affords. Besides this, great facilities would be found in obtaining cheap and extensive yards for dressing the stone previously to shipping it for market, and the price of subsistence for workmen would be less than in larger cities. The stone from these quarries, I understand, is of an excellent quality; and the granite trade has already become a very important branch of domestic commerce.

A great deal of wood, still growing in the neighborhood of our line, would be sent to market if the road were completed; as would also charcoal, and many domestic articles which do not bear the cost of transportation under existing circumstances.

It is particularly recommended to the company, to reduce as low as possible the cost of transportation on *lime*, in order that it may be used extensively in the adjacent country for agricultural purposes. This policy will operate directly by adding immediately to your receipts, and in the course of time, as the country improves in population and resources, by constantly increasing your revenue. By these means you would not only consult the interests of the stockholders, but would add materially to the wealth, population and general convenience of Anne Arundel and Prince George's counties, and indirectly to other portions of the State.

As this road will render Annapolis an outer or winter harbor for Baltimore, it is probable that a large quantity of merchandize, owned in the latter city, will be annually imported at Annapolis, and pass over this road to its destination, thus adding to the revenues of your company.

The transportation of ore, fuel and supplies to, and of iron from, the Patuxent furnace will also contribute to your dividends, and they will be yet further increased by a good deal of travel, and transportation of tobacco and other agricultural productions, from Prince George's. The branch road of 1 1-4 miles, shown on the map, would terminate at the furnace, and would no doubt amply repay the stockholders for their investment. This branch may be made for about $8,000, or less as there is no heavy work in it of any description, and indeed the principal cost will be in the laying of the rails.

The daily mails to and from Annapolis will of course be carried on this road, and will increase your receipts.

Another source of revenue will be found in the coal trade from the Chesapeake and Ohio Canal. This cannot, perhaps, be relied on with certainty, except in case of severe winters. But as a general rule, whenever the navigation at the north is closed, it is likely that a large quantity of coal will be transported from the District of Columbia by railroad to Annapolis, and thence shipped to market. The Cumberland coal ought not, under ordinary circumstances, to cost over $5.00 per ton, including all reasonable expenses for transportation to New York or even to Boston; yet that species of fuel is seldom less in those cities, during a tolerably hard winter, than $13,00 per chaldron of 36 bushels, the ton being 30 bushels. Of course this article would well justify the expense of transportation on rail-

roads from the District of Columbia, under these circumstances; and it is indeed probable that every winter more or less would be shipped from Annapolis, the quantity depending on the price of the article in New York.

Looking to these various sources of revenue I can entertain no doubt that this road, considering the comparatively cheap cost at which it may be made, will yield a fair return in dividends for the money invested in its construction.

But he who would measure the utility of a public work by its revenue alone, would take but a narrow and most illiberal view of the subject. No man can estimate with tolerable precision the advantages which result from a judicious system of internal improvements; for the benefits they confer on the community are so ramified, complex, and widely diffused, and in some instances so silent in their operation, that it is almost impossible fully to appreciate them. The statesman and the political economist justly regard them as the powerful instruments by which the condition of mankind has been ameliorated, the natural resources of the world developed, and distant nations, formerly separated by jealous rivalry, are united in the bonds of common interest. The internal improvements of Pennsylvania have cost nearly $23,000,000, and it has been estimated that the increased value of property, in consequence of those improvements, exceeds $100,000,000. Notwithstanding the internal improvements in that State are incomplete, and many of its works imperfect, it is a most triumphant fact, that during 1837, a season of most unusual depression in business, the receipts from that system of public works exceeded $1,600,000 or 7 per cent. on the whole cost. The nett dividend, after paying all expenses, was something over 5 per cent., and it is supposed that for the present year it will exceed six per cent. As her loan is a five per cent stock, she may be regarded as already out of debt, and likely to fill her coffers, thus relieving her citizens from taxation with the fruits of her responsibility and public spirit. Yet who can pretend to calculate the value of the advantages which that State has derived, and is likely to derive, from her domestic policy, in her increased population, agricultural and mechanical productions, in the discovery and working of her mines, and in bringing her waste and unproductive lands into cultivation? "It has," says a committee of the Pennsylvania Legislature, "raised up in our former uninhabited districts an intelligent and permanent population; and converted the mountains into theatres of busy life, and our hitherto waste and valueless lands into sites for flourishing and populous villages. Its benefits are not alone confined to those engaged in trade, but are becoming *general* and *universal*."

It appears to me that the advantages likely to result to the city of Annapolis from the construction of this railroad are manifold and obvious; and that few works in this country are better designed, in proportion to cost and extent, to subserve more useful purposes. It is unnecessary for me more than to hint, in addition to what has been already said at some of the benefits, which may be anticipated from this improvement.

The natural position of Annapolis is commanding and important. Its fine and commodious harbor, seldom closed with ice, its proximity to the federal capital and the capes of Virginia, its neutral and convenient position between the north and the south,—confer on this city great advantages for commerce, and especially recommend her to the notice of the General Government as, under every view of the subject, decidedly the best locality in the United States for the site of a Naval Academy. Such an institution has long been a favorite project with the friends of the Navy, which

include all classes of citizens; and as the objection which has heretofore been urged against Annapolis on the ground of its difficult accessability in the winter, will be removed by the construction of the railroad, it is to be hoped that Congress will no longer delay yielding to the popular feeling on this interesting and important subject.

Annapolis also possesses many conveniences as a Naval station. It frequently happens that it becomes necessary to despatch an armed vessel to sea on an emergency, when it is difficult to send instructions to any of the present stations. In the winter when the water communication with Norfolk is closed, considerable delay would be experienced in getting a vessel to sea, if orders were sent to that yard by land. This is also true in relation to army movements, and it is well known that, in the winter of 1836, great difficulty and delay were encountered in transporting troops from Baltimore to Florida, whereas if this road had been made, their movements might have been greatly accelerated by embarking from Annapolis. And indeed it is well worthy of consideration whether it should not be the policy of the government to keep a large military force and stores at Fort Severn, ready to be removed, at any moment, when the exigencies of the service might require their presence elsewhere.

When the Baltimore and Ohio railroad is completed to the Ohio, Annapolis will enjoy a portion of its blessings, not only as a useful auxiliary to Baltimore, but as a direct participant in the great trade of the West. The difference by railroad being only about 20 miles, a distance of no account on so long a line. As Baltimore increases in population and wealth, the relations existing between her and Annapolis, will become more intimate and mutually dependent; and the latter will share in the prosperity of the former; and such, indeed, may be said to be the true position occupied by the different portions of the State towards its great commercial emporium, which, like the heart of the human body, elaborates the *life blood*, that in its circulation carries health, strength and energy, to the extremities of the system.

The favorable influence which the construction of this road is likely to exert on the value of the lands in its vicinity has been already adverted to; and as the mere statement of the proposition must make it perfectly apparent, it is quite unnecessary for me to enlarge further on the subject, than to observe, that the great benefits which have resulted to the agricultural interests in this State, from the investigation of Professor Ducatel, in relation to calcareous and alkaline manures, must prove a source of real congratulation to every citizen of Maryland.

I owe an apology to the Board for the mutilated and defaced appearance of the drawings, which is owing to a fire having originated in the building occupied as an office, from which they were rescued in their present condition. The same cause must explain any inaccuracies which may have crept into this report, as it has necessarily been prepared in great haste. All the materials I had collected for the report, and all that I had written previously to the fire, were entirely consumed. I have therefore omitted many details, and much that I had intended to say on several subjects connected with this improvement.

In conclusion, it affords me great pleasure to acknowledge the valuable services rendered by my principal assistant, Alexander Evans. I feel myself greatly indebted to his intelligence, skill and industry.

I have the honor to be, gentlemen, Your obedient servant,

GEO. W. HUGHES, U. S. Civil Engineer,
Chief Engineer of A. & E. Railroad.

The detailed estimates accompany this report as an appendix; and I take

the liberty of suggesting to the board that it would be improper to publish the estimates, as I believe the *prices* are higher than offers will be made to do the work for.

REPORT ON THE PROGRESS OF CONSTRUCTION OF THE ANNAPOLIS AND ELK RIDGE RAILROAD.

ENGINEER'S OFFICE,
January 1st, 1839.

To the President and Directors of the
Annapolis and Elk Ridge Railroad Company.

GENTLEMEN:—On the 6th of February 1838, my report of the 30th of January preceeding, in relation to the surveys and location of the Annapolis and Elk Ridge railway, was adopted by your Board; and I was directed to make all the necessary preparations for a speedy commencement of the construction of the work. Under this authority, I advertised for proposals to undertake the graduation and masonry, on the 20th of April following. This "letting" excited much competition among old and experienced contractors, and the Board was thus enabled, on the 29th of May, to contract for the entire work, under advantageous circumstances, for the gross sum of $158,157. Subsequently, some changes of plan and location were ordered by the Board, which added somewhat to this amount. These changes will be hereafter explained.

Previous to the "letting," there was but one change made in the old location, and that in accordance with a suggestion in my report of the 30th of January. This alteration was made at Mr. Hodges', and induced a very considerable saving of expense, besides improving the trace of the road.

After the contracts had been perfected, the Board directed me to locate a line diverging from the one already adopted, soon after crossing Chandler's run, as near to the Patuxent furnace as the nature of the ground would permit. It was conceeded on all sides that this line was inferior *in the abstract*, to the old or upper line, but the Board properly regarding it as a question of policy, were induced by the propositions and representations of the Messrs. Ellicott to adopt this new line, by which they doubtless consulted the interests of the company. This change involves an additional expense of $3,450, to be defrayed by the Messrs. Ellicott, the proprietors of the Patuxent furnace, who have in addition, given the free right of way through their own grounds, and have secured without charges to the company, the right of way through other portions of the line, making in all, perhaps, nearly one-fifth of the entire length of the road. This liberal and public spirited example, I am sorry to say, has been followed by only two other proprietors on the route,—Messrs. Nathan Warfield and William H. Baldwin, both of Brotherton. On other portions of the line, the land damages have been high, but not as extravagant as on many other similar works in the State.

The original plan adopted by the Board for crossing Chandler's run, was by a wooden Truss Bridge, 600 feet in length, on stone piers, after Col. Long's Patent "Jackson Bridge." But subsequently, on reports from a committee appointed to inspect the locality, and from the Chief Engineer, the Board in view of the superior permanency of the plan then suggested, determined to effect this crossing by a heavy earth embankment, and a stone arch of 20 feet chord to discharge the water of the creek. This change of plan involved an additional cost of $7,526 56 chargeable to the company. These are, I believe, the only deviations from the original project on the entire line. A minute description was given of

the location in my first annual report. I beg leave to refer to that document for all information that may be desired on that subject.

The actual construction of the works was commenced in June last, but was not prosecuted with much vigor till July. From that time to the present, it has progressed with as much rapidity as the means of the company would warrant. Nearly all the work of this description is already finished, leaving in fact only 200 perches *dry masonry* still to be laid. The amount of requisitions issued from this office under this head is $24,883 02, exclusive of the 20 per cent, leaving to be paid on final estimate, excluding the 20 per cent, $7,048 13.

RECAPITULATION.

Total cost of graduation,	$128,318 46
" " masonry,	33,041 50
	$161,359 96
Deduct amount to be paid by Messrs. Ellicott,	3,450 00
Total,	$157,909 96

For something closely approximating to this sum, there can be no doubt the work will be completely finished; for if any of the contractors should abandon their sections, of which I trust there is no probability, a sufficient sum will remain in the hands of the company, of the retained 20 per cent, to meet the additional cost incident to a re-letting.

In planning the work, care was taken that the slopes of the excavations and embankments should be nearly those which it was supposed the dirt would naturally assume; and experience has shown that the assumptions for the different kinds of earth were nearly or quite correct. In consequence of these precautions, and the care bestowed on their construction, the embankments though still in a green state, and notwithstanding the very unfavorable autumn and winter, have preserved their forms uncommonly well; and indeed, where they have been carried to their full height and have been properly dressed, no washes of any consequence have taken place. This is a most gratifying result, as it ensures the stability of the work, with slight repairs.

The masonry has been generally well executed. In planning the different structures, strength and durability, rather than ornament and show, were consulted; yet it is believed that the arched bridges over Rogue's harbor and Chandler's run, will not suffer in a comparison with buildings of a similar character on other works. These bridges, (and all the small culverts on the first seven sections,) with the exception of the arch at Chandler's run, which is built of granite, are constructed of a hard sandstone, which is easily quarried and readily dressed to a pattern. The two principal localities of this stone, are near Cecil's, and at Nathan Warfield's. Some of these rocks are a conglomerate of quartz pebble, united with a ferruginous cement, but they are difficult to dress, and are only fit for rough work. The stone for the lower portion of the line was brought from Jones' Falls and from Port Deposit. In consequence of the absence of sufficient stone of a proper character on the 8th section, two culverts, one of them large, were built of brick. This has added considerably to the cost of masonry, as the bricks were brought from Baltimore. It would have been cheaper if the bricks had been burnt on the ground, but for a long time I had hopes to find stone in the vicinity of a nature suitable for our purposes, but was forced at length to abandon the idea, when it was too late to burn the bricks for ourselves. The stone found on Warfield's farm may hereafter prove valuable as a building material, in consequence of its accessa-

bility, its fine texture, durability, and the convenient forms in which it may be quarried and wrought. We have on hand about 50,000 bricks, which are intended for the centre depot.

The geological formations of the country have been found to agree perfectly with the assumptions in my last annual report. In speaking of the deep cut near Sappington's, on the 4th section I remarked, that "it is not impossible that this cut may develope the presence of rock, although none is to be seen near the surface,"—this has turned out to be the fact, and considerable rock has been encountered. As it was not to be supposed that the contractor could form a very correct opinion, before commencing operations, of the formation of the country, and as his work has been taken at a low rate for ordinary graduation, I think it but just that some extra allowance should be made to him, but to what extent I have not yet the means of ascertaining. This will not, however, materially increase the cost of graduation; and there is no other case on the road where there would be any propriety in extending extra compensation.

SUPERSTRUCTURE.

In relation to the superstructure I have heretofore submitted the following report:

ENGINEER'S OFFICE OF ANNAPOLIS AND ELK RIDGE RAILROAD.
November 12th, 1838.

To Somerville Pinckney, Esq.
President of Annapolis and Elk Ridge Railroad.

SIR:—The rapid progress with which the graduation and masonry have been executed up to this date, renders it important that the Board should decide without delay, on the kind of superstructure to be used on our road, in order that arrangements may be made to procure, during the ensuing winter and spring, the materials necessary for its construction.

If there should be no suspension of operations nor any unforseen difficulties arise, the entire graduation and masonry will be completely finished early in the month of May next; and the laying of the rails should be commenced immediately thereafter, say the first day of June at the farthest. The whole track may be laid in six weeks from the time of begining, if it should be deemed important to have it finished so early; but it will probably be advisable, both as it regards the quality of the workmanship, and the economy of construction, that double that time should be devoted to it. This will bring it to the 1st of Sept. 1839, on which day the road may be opened for regular business.

One advantage in extending the time for laying the track will result from the fact that as the work progresses, the rails, mud sills and other materials, may be conveyed on the road to the places where they are wanted; thus diminishing the cost of transportation; and one party could lay all the rails in the course of three months, which would probably decrease the price of workmanship.

We omit the discussion of the various forms of superstructure and proceed with that portion of the report which treats of the plan adopted.—Eds. R. R. J.

The third or bridge rail is also an American invention and was first adopted on the Wilmington and Susquehanna road. Subsequently it has been used in a modified form, on the Great Western railroad, from London to Bristol, England, one of the most magnificent works of the kind in the world. With a given weight of metal, this is clearly the strongest form

at present used, and it is this rail I now have the honor to recommend to the Board for adoption. In order that all the arrangements for the proposed superstructure may be clearly understood by the Board, I have caused patterns, of the precise size of the different parts to be made for illustration, and am prepared to give any verbal explanation which may be required.

The rail I have recommended is larger and heavier than the Wilmington rail, and weighs 43 lbs. to the linear yard. This rail is I have no doubt, at least as strong as a 50 lb. rail of any other form.

I propose to lay this rail in the following manner, viz: First, white pine plank 3 by 8 inches, firmly bedded in sand or gravel; this is the *sub sill*, the uses of which have been already explained: on this will be placed, and fastened to it with a *tree nail* the cross ties of white oak or chestnut 7 1-2 feet long by 6 inches square, when dressed, placed at intervals of 2 1-2 feet apart. On the *cross ties* (dispensing with the wooden stringer,) the iron rail will be fastened into a double chair at each end, and into a single intermediate chair, as shown by the model. The double chair weighs 7 lbs. and the single 4 1-2 lbs. The rail will be still further secured in its place by wrought iron spikes (weighing 7 oz.) to each cross tie. It is proposed to prevent a longitudinal movement in the rail by a transverse ledge on the chair to fit into a hollow in the rail.

The cost of one mile of *railway*, on the above plan, is estimated as follows, viz:

25,000 feet board measure of white pine plank in lengths not less than 15 feet (including 3880 feet for extra bearing under joints of rails) delivered at Annapolis or Baltimore for $15,00 per M.,	$375 00
2112 white oak or chestnut cross ties at 18 cents each, delivered on line of road at convenient points,	380 16
704 cast iron chairs (7 lbs. each) at 3 1-2 cents per lb.,	172 00
352 intermediate chairs [4 1-2 lbs. each] at 3 1-2 cents per lb.,	55 44
8448 wrought iron spikes (7 oz. each) being 3696 lbs. at 8 cents per lb.,	295 68
Workmanship,—laying track at 45 cents per linear yard,	792 00
67 tons iron rails delivered at Annapolis or Baltimore at $66 00 per ton, (exchange 10 per cent.)	4,422 00
Hauling and distributing materials on road,	250 00
Clearing up ditches, &c.,	100 00
	$6,467 28
Or, in round numbers,	$6,500 00
Then add for contingences of various kinds including superintendence,	500 00
Total estimate of 1 mile of superstructure,	$7,000 00
Then for 20 miles of road, total cost of superstructure,	$140,000 00

RECAPITULATION.

For superstructure as above,	$140,000 00
For graduation and masonry,	$157,909 96
For contingences of various kinds, such as crossings of county roads, farm bridges and roads, changes of roads, paved drains and ditches, &c.,	11,000 00
Expense of Engineering,	12,000 00
" " Office,	1,300 00
Contingences of do.,	600 00
Right of way,	16,000 00
For one turn-out,	1,000 00
Total amount,	$339,809 96

The subscriptions to the road are, I understand, in round numbers $353,000, leaving a balance after the completion of the road, to be applied to the moving power and fixtures on the road, of $13,190 04.

I believe all the estimates to be sufficiently liberal; and if so, the funds of the company will prove more than sufficient to completely finish the road in all its parts.

One great expense, and indeed the principal one, attending the repairs of railways is attributable to the perishable materials of which they are mainly composed. A process has, however, been discovered in England, by which wood is said to be rendered nearly imperishable or at least greatly retarded in its decomposition. This process is called *kyanizing*, after Mr. Kyan the discoverer; it consists simply in saturating the timber with a strong solution of *corrosive sublimate*, which it absorbs. This invention is now used by the British Admiralty in all their wooden constructions. They have experimented on it extensively, and to their entire satisfaction. It is also at this time used generally in England, and its application is not confined to the protection of wood alone but has been extended also to canvass, and is found to answer an excellent purpose for the preservation of that material from decay. The decomposing operation in timber begins in the sap wood, and the albumen must be in a fluid state, or capable of becoming so, before it can furnish food for the *fungi*, which many persons believe to be a most essential element of what is termed *dry rot*, or more properly *sap rot*. Be this as it may, and waiving all discussion of the causes which lead to the rapid decay of timber, it is sufficient to remark that Mr. Kyan's process, it is well ascertained, acts by effecting the solidification of the albumen more especially of the sap wood: thus diminishing, or entirely preventing its liability to fermentation or capability of being dissolved to furnish a pabulum for fungi.

Among other distinguished Philosophers, Prof. Faraday has carefully investigated this subject so far as chemical science can throw any light on it, and he reports most favorably of the plan; and we have the concurrent testimony of the most eminent British Engineers and Architects in favor of its utility. From all these facts, which are well understood in Great Britain, there can be no doubt of the vast importance of this discovery; and I cannot refrain from recommending a trial of it on our road, at least for the protection of the *under sills*. I have been politely furnished by the U. S. Navy Commissioners with a communication relating to experiments instituted on Kyan's process, under the directions of the Navy Board. It appears by this report, that the cost when due economy is observed in the experiment, is from 1 to 1 1-2 cents per superficial foot of 2 inches. This corresponds with one linear foot of our *sub sill*. The entire length of *sub sill* is 211,200 feet, which, at 1 1-2 cents per foot will amount to $3,168 00.

It is a matter of peculiar gratification to me to be able to state to the Board, that so far, although the most heterogenous materials have been employed on the road, consisting of whites, and blacks, North Americans, Irish, English, and German, no unpleasant occurrences, no riots nor tumults have taken place, nor have I heard of any depredations having been committed on the farms in the vicinity. Indeed, the inhabitants along the line speak in favorable terms of the conduct of the laborers. This state of things is mainly owing to the good example of the contractors, to the promptitude with which their wages have been paid, and to the prohibition of the use of spiritous liquors.

Some slight inconveniences have been experienced from the culpable negligence of the former resident of the Second Division, who has in con-

sequence been dismissed from the service of the company. The present organization is as follows:

First Division.

A. H. Mandeville, Resident.
J. J. Williams, Assistant.
W. H. Drayton, 2d Assistant.

Second Division.

Alexander Evans, Resident and Principal Assistant.
T. Donaldson, Assistant.
J. E. Addison, 2d Assistant.

To all these officers I feel greatly indebted for their industry, intelligence, devotion to the interests of the work, and correct deportment as gentlemen. To Mr. Evans, especially, the Principal Assistant, I am under many obligations for his uniformly valuable services.

Journals have been kept, by the resident engineers, of the daily transactions on the road—of the plans of the culverts, and of the various directions given to the contractors. All orders, regulations and communications from the chief engineer, in reference to the work, have been entered in a report book; and a regular record has been preserved of all the requisitions issued from the office in favor of the several contractors. These papers are, at all times, at the service of the Board.

In conclusion, I beg leave to congratulate you, gentlemen, on the successful prosecution, thus far, of your important enterprise; and to express the confident hope, strengthened by every days observation, that the citizens of Annapolis will hereafter derive from this improvement an ample reward for their liberality and public spirit.

I have the honor to be, gentlemen, Your Obedient Servant,

GEO. W. HUGHES, *Chief Engineer.*

COMMITTEE ON SCIENCE AND THE ARTS.—REPORT ON E. TILGHMAN'S RAILWAY BAR.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an improved Railway Bar, invented by Mr. Edward Tilghman, of Philadelphia, Penn., *Report:*

That "the nature of the improvement consists in so forming the bar that there shall be a reduction of the hight usually given to the T rail between its head and the base on which it rests: thereby diminishing the leverage of the rail, while its strength and capability of being firmly secured to the cross tie, are provided for by the addition of a rib directly under the centre of the base, which rib may be made plain, trapezoidal, or with a lower web.

To fasten the rail, the lower rib is inserted in the cross ties, and wedged securely to its place, where it is supported conjointly upon the ordinary base, and the under part of the lower web. A chair, or flat plate of iron, is inserted immediately under the upper base, or support, to receive which, notches are made in the ends of the bars, so that when two of them are put together, these notches form a mortice through which the chair is to be inserted. The chair is affixed to the cross ties" by spikes or screws.

The Committee having tested the strength of the improved *trapezoidal* rail, weight 48 lbs. per yard, by the rules laid down by Professor Barlow in his account of "Experiments on the transverse strength and other properties of malleable iron, with reference to its uses for railway bars," feel

satisfied it will sustain a weight of from six to seven tons without injury, [the supports being 33 inches apart] or about 75 per cent. more than the most approved rail of similar weight now in use.

With reference to *leverage*, the improved rail is decidedly preferable to the T rail, the distance between the upper surface and support being considerably less, and as its entire depth is greater than that of any other rail known to the Committee, [and may be increased at a slight expense without changing the position of the main support, or increasing the leverage,] it consequently follows, as the depth governs the deflexion, that the improved rail is much the most stiff and rigid.

In point of economy, the Committee are of opinion that the improved *trapezoidal* rail will be found less expensive than the T rail. The plan suggested for connecting the bars, and attaching them to the sills, they conceive permanent and simple.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

March 14, 1839.

REPORT ON EASTWICK AND HARRISON'S EIGHT WHEEL LOCOMOTIVES.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination Messrs. Eastwick & Harrison's Eight Wheel Locomotives, *Report:*

That these engines possess two peculiarities of an important character; one in the arrangement of the driving wheels, and the other in the mode of maintaining the fire draft.

It is well known to engineers, that the efficiency of the locomotive engine depends, first upon the quantity of steam which the boiler may be capable of generating in a given time, and secondly on the amount of friction, or, as it is technically termed, adhesion, between the driving wheels and the road. As the adhesion increases with the weight, it is evident that the engine becomes more effective by increasing its weight, and by throwing a greater proportion of this weight on the drivers.

But a limit to this increase of weight arises from the incapacity of the road to sustain the great pressure thus thrown on a small bearing surface.

To obviate this difficulty, engines have been made with all the wheels coupled so as to constitute them all drivers, and thus distribute the *adhesive* pressure over a greater extent of the road.

Engines of this description are used for heavy and slow draught, but are considered unsafe, from their liability to be thrown off the track at curves.

Another plan, patented a few years back by an engineer of this city, was to use four drivers, and at the same time to carry the front end of the engine on a guide truck, as in the six wheeled engine. But here a new difficulty arose in consequence of the engine having three points of bearing in the line of the rails, on which its weight could not be properly distributed, unless the road was entirely free from irregularities of surface: a condition not to be found on any of the roads which have come under the notice of the Committee.

The improvement invented by Messrs. Eastwick and Harrison is designed to obviate this difficulty, by giving to the eight wheel engine only two bearing points, one on the guide truck, and the other on a frame supported by the driving wheels. The axles of the drivers are placed one in front, and the other behind, the fire box, and are confined between pedestals of the

usual form fixed to the main frame of the engine, which allow vertical play, but prevent any horizontal motion.

The bearing pins, instead of abutting against springs fixed to the frame in the ordinary manner, are jointed to the extremities of horizontal beams of cast iron, one of which is placed on each side of the engine.

To the centre of these beams, or levers, are jointed wrought iron rods, which pass down through the engine frame, and carry the springs which support the weight of the engine. The connecting rod of the piston is attached to the hinder wheel, and this communicates motion to the front driver by a coupling rod attached by a ball and socket joint.

It is evident that this arrangement will allow to each driving wheel, an independent vertical motion, with the advantage that the engine will partake of only one half the vertical motion of either wheel, in consequence of being suspended at the centre of the horizontal sustaining beam.

The front drivers are without flanches, in order to avoid any difficulty in turning curves.

The peculiarity in the means of maintaining the fire draft, is an apparatus for equalizing the effect of the exhaust steam in the smoke stack, somewhat similar to Gurney's contrivance.

Instead of exhausting directly into the stack, the exhausted steam enters two copper chests, one connected with each cylinder, and escapes from these into the chimney through a number of small tubes.

With the aid of this contrivance the anthracite fire is kept in a state of intense activity, and generates an abundance of steam without the annoyance and danger arising from the smoke and sparks of a wood fire.

The heat of the anthracite fire has been found so great as to melt down the grate bars of cast iron which were used in the first experiments with this fuel.

Messrs. E. & H. have since substituted grooved wrought iron bars, which are protected from the action of the fire by a coating of clay placed within the grooves.

A trial of one of these engines on the road between Broad street and Peter's Island, was witnessed by several members of the Committee, on the 25th of April last.

It happened unfortunately, on that occasion, that the business of the road did not furnish so many cars as were desirable for a fair experiment.

The particulars so far as made known to the Committee, were as follows:

Weight of engine, 28,350 lbs., Weight on drivers, 18,059 lbs.
Cylinders, 12 inches diameter, Steam, 90 lbs. to square inch.
Length of stroke, 18 inches, Driving wheels, 44 inches diameter.

The train consisted of 32 loaded cars, estimated at 5 tons each, 2 empty cars weighing 9800 lbs., and tender, 5 tons making a total of 169 tons. This train was started with great ease on a rising grade of 27 feet to the mile, and drawn to the foot of the inclined plane, the distance being about 3 miles, partly on a rising grade of 35 feet to the mile, with several short curves, and the road in such bad condition as to keep the sustaining beam in continual vibration.

A few days after this experiment, one member of the Committee had an opportunity of witnessing a more decisive trial of the power of the engine.

On the latter occasion, the train consisted of 34 single cars, estimated at 5 tons each, 4 double cars, 10 tons each; one of Mr. Dougherty's iron boats 50 tons, and the tender 5 tons; total, 265 tons.

This train was started without difficulty, on the same rising grade of 27 feet to the mile, and drawn over the 35 foot ascending grade and short curves with apparent ease, and with steam blowing off during the whole trip.

This highly interesting experiment was brought to a close somewhat abruptly after proceeding about 2 miles, by the breaking down of one of the cars near the middle of the train.

Although this accident abridged the trial of the power of the engine for draught, it afforded an apportunity of displaying another excellent trait in its performance, this was the facility of reversing* while under way.

As soon as the accident happened, a person stationed on the after part of the train passed a signal to the engineer, the latter immediately reversed the engine and brought the enormous moving mass to a stand before it had run half its own length. The satisfactory character of the experiments detailed above is sufficient to enable any one who is conversant with transportation on railroads, to form a correct opinion of the merits of this engine. The impression of those members of the Committee who witnessed the trials, is, that it is well adapted for the use of anthracite as fuel, and for very heavy draught; with less tendency to injure the road or to receive injury on a bad road than engines of the usual construction.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

May 9, 1839.

At the request of Messrs. Eastwick and Harrison, the Committee insert the following letter from A. Pardee, Jr. Esq., Engineer of the Beaver Meadow Railroad, in reply to their letter requesting information relative to the construction of the road and the performance of their engine upon it.

COM. PUB.

Hazleton, Pa., June 8th, 1839.

MESSRS. EASTWICK & HARRISON,

Gentlemen--I have received your's requesting information as to the construction, &c. of the roads in this region, on which your eight wheeled Locomotives are employed.

The Beaver Meadow railroad, where one of those engines has been in use two years, has an iron plate rail of 2 1-4 by 5-8 inches; the wooden rails or string pieces, are oak, a portion 5×7, the remainder 5×8 inches; where the 5×7 rails are used, the cross ties are placed three feet from centre to centre, where the 5×8 they are four feet. The cross ties are laid on plank mud-sills 2 1-2 inches thick by 10 to 12 inches wide. The shortest curve has a radius of 300 feet; length about 200; but at the foot of the inclined planes, there is a curve, around which the engines now daily pass, the radius of which is 250 feet, the length about 300. The heaviest grade is 96 feet per mile, at two points, about 3-4 mile each, there is an average grade of 80 feet per mile for 5 miles—on the heaviest grade the shortest curve is 550 feet radius, the length about 400 feet. The Hazleton railroad on which two of your eight wheel engines are now in use, has a plate rail 2 1-4 by 5-8 inches, the string pieces are yellow pine 5×9 inches, the cross ties 4 feet apart, from centre to centre, the mud-sills 2 1-2 by 10 to 12 inches. The heaviest grade is 140 feet per mile for 1 1-2 miles; this part of the road was not intended, when made, for the use of locomotive power, but it was found in practice that by doubling our trips we could use the engines with more economy than horse power. In regard to the effect on the road, so far as my experience goes, and I have seen the two classes of engines in daily use for more than two years, I would say that the eight wheel engine was easier on the road than a six wheel engine of the ordinary construction,

* For a report on this mode of reversing, see Journal of Franklin Institute, vol. xviii., p. 179.

with the same weight on the two driving wheels as on each pair of the driving wheels of the eight wheeled.

There are now in use on the Beaver Meadow and Hazleton railroads, seven locomotive engines with horizontal tubular boilers, in which anthracite coal is exclusively used as a fuel after the first fire in the morning, and that we continue to use it when we can have wood for the cost of cutting, is sufficient evidence that we find it to our advantage. We have the Hercules at work, and so far, she performs well, running around the curves with great ease.

Respectfully yours,

A. PARDEE, JR.

THE READING RAILROAD: ITS ADVANTAGES FOR THE CHEAP TRANSPORTATION OF COAL, AS COMPARED WITH THE SCHUYLKILL NAVIGATION AND LEHIGH CANAL. NOS. I. TO VIII. BY W. EDWARD.

To Elihu Chauncey, Esq., as a tribute of admiration for the eminent services he has rendered to the Reading Railroad Company, by his able, firm, and enlightened advocacy of its true interests.

READING RAILROAD.—NO. I.

The great importance to Pennsylvania of a cheap means of transporting her Anthracite Coal from the mines to the sea-board, has engaged much of the time and attention of her scientific men, and large sums of money have been expended in various undertakings with a view to this object.

Among the most successful of these are the Schuylkill navigation company's canal, and that of the Lehigh coal and navigation company, in connection with the State canal on the Delaware.

The project of a continuous railroad from the mines at Pottsville to the river Delaware first received the legislative sanction in 1833, the work was commenced in 1835, and has since that period been steadily and rapidly advancing towards completion.

So far as it has progressed, the Reading railroad, will, it is believed, bear comparison with any similar work, and is generally conceded to be one of the best constructed railways in the United States.

The object of these papers will be to show, according to the experience of railway companies in England engaged in the transportation of coal, and from other known data, the advantages of this road when compared with the other avenues by which our anthracite is at present brought to market, particularly with the Schuylkill navigation and Lehigh canal—these being acknowledged the most successful works *yet* in operation.

In the commencement, as I purpose to enter fully into detail, it may not be amiss to notice an erroneous impression entertained by many, who say, generally, that "canals are cheaper than railroads as a means of transporting heavy freight."

I am well aware that many canals are a much cheaper means of transportation than railroads, but in inquiring into this subject fully, it is necessary that all attendant circumstances be taken into account.

Thus it may be said, that the cost of transporting heavy goods is less per ton by the Duke of Bridgewater's canal than by the Liverpool and Manchester railway; but it must be borne in mind, that this canal is a level of 27 miles with only one set of locks, four in number, at its entrance into the river Mersey, with sixteen miles of tide-way by that river to Liverpool, and that the Liverpool and Manchester railway has ascents and descents varying from 6 feet to 55 feet per mile.

When, however, we compare a canal, such as the Schuylkill navigation

company's 108 miles long, having 117 lift locks, overcoming in all a fall of 610 feet, and changing from one side of the river schuylkill to the other—with the Reading railroad, 94 miles in length, having in its course from the mines no ascent whatever to overcome (with the exception of about a mile between the Delaware and Schuylkill, where the assistance of an additional locomotive will enable the trains to pass without delay,) the line generally varying from a level to descents of 19 feet per mile—it will be perceived that the result of the comparison may be widely different.

READNIG RAILROAD.—NO. II.

This railway commences at Pottsville, and there connects with the Mount Carbon railroad, and by means of it with the Danville and Pottsville railroad. It will also, at the same place or at Mount Carbon, half a mile below Pottsville, be connected with the Mill Creek and Schuylkill Valley railroads, either by the extension of one or other of these last named railroads, or by a branch of the Reading railroad of less than two miles to Port Carbon. At Schuylkill Haven, four and a half miles below Pottsville, it connects with the Mine Hill and Schuylkill Haven railroads; and at Port Clinton, 15 miles below Pottsville, it connects with the Little Schuylkill railroad, by which latter railway the Lehigh coal and navigation company can transport their coal to the Reading railroad.

It will thus be perceived that the Reading railway connects with all the railroads in the coal region, by which the coal is at present brought in *cars* to the Schuylkill canal; and that by means of the Little Schuylkill railroad, which reaches the valuable coal lands of the Lehigh company on the west, *they, also, will be enabled* to reach the Reading railroad at Port Clinton.

From Port Clinton the Reading railroad continues down to Philadelphia, passing through Reading and Pottsgrove, and terminating on the river Delaware.

Within five and a half miles of its termination, a branch road on the west side of the Schuylkill, two miles in length, connects with the Columbia railroad, at the west end of the Columbia railroad bridge.

There are no ascents whatever on this road in its whole course from the mines, [with the exception of about a mile between the Schuylkill and Delaware, where the assistance of an additional locomotive will enable the full trains to pass without delay;] the line generally varies from a level to descents of 19 feet per mile, and is without precedent as regards its peculiar aptitude to the trade it is intended to accommodate.

As the capability of this railway, with all its advantages, entirely to supersede the Schuylkill navigation and Lehigh canal is frequently denied by persons interested in these companies, it will be necessary to ascertain their present means of transportation, and *hereafter* to examine the cost of freighting, labor, wastage of coal, &c. by these channels, and see what reductions can be made by them when *forced* thereto by the operation of the Reading railroad.

And first, we will inquire what constitutes the Schuylkill navigation? The works extend from the dam at Fairmount, near Philadelphia, to Port Carbon, and consist of a succession of canals and pools. The pool above Fairmount dam is entered by a short canal on the west side of the Schuylkill—this pool extends about six miles to Flat Rock. About one and a half miles from Flat Rock Dam, the Manayunk Canal leaves the last mentioned pool and rejoins the stream a short distance above the dam, and thus enters the second pool. This extends four miles to an inconsiderable canal, which connects it with the pool above; three miles further, another

small canal conducts into the pool above Norristown; thence the stream is ascended by several short canals and pools to the commencement of the Oak's canal, three and a half miles in length. The Oak's canal commences half a mile above the outlet of Perkiomen Creek, and extends along the north or left bank of the Schuylkill, to a dam, about one mile above Phœnixville, where it enters the river. The pool, formed by the dam just mentioned, extends to the outlet of the Vincent canal, nearly five miles in length. About one mile above the termination of the Vincent canal, commences the Girard canal, one of the most extensive in the series. It is twenty-two miles in length, and extends along the right bank of the Schuylkill to Pigeon Creek, five miles below Reading. Between that point and Reading there are two dams and a small canal. With the exception of the Hamburg canal, ten miles in length, and another of three miles, the distance from Reading to Hamburg is traversed by a succession of short canals, mostly on the left bank of the Schuylkill. This is also the case from Hamburg to Port Carbon, where the navigation terminates. The canals are twenty-seven in number, and in length 58 miles—there are thirty-four dams and pools—length of pools 50 miles—entire length, 108 miles. The canals are thirty-six feet wide at top, twenty-two at bottom, and three feet six inches deep. There are one hundred and seventeen lift locks, each eighty by seventeen feet—one tunnel 385 feet long—total rise 610 feet. With a few exceptions the locks are double on the whole line.*

On the first day of January, 1839, the affairs of the Schuylkill navigation company stood thus:

Capital stock 33,312, shares at $50,		$1,665,600 00
Permanent loans,	1,914,166 93	
Amount paid,	75,743 97	
		1,838,422 96
Bond payable given for damages,		8,000 00
Temporary loan from toll fund,		52,205 12
		3,564,228 08
Deduct—Bonds receivable for lands sold,	13,958 18	
Contingent funds,	18,625 81	
		32,583 99
		$3,531,644 09

Assuming the market price of the stock at $150 per share, it would add to the above $3,331,200—making in all six millions, eight hundred and sixty-two thousand, eight hundred and forty-four dollars and nine cents [$6,862,844 09]. But as the purpose of these papers is to show the advantage of the Reading railroad over the Schuylkill navigation and Lehigh canal, it would not be correct to look to the market price of their shares, but base our estimates on their par value.

The annual cost of the Schuylkill navigation is:—

Six per cent. on capital stock, $1,665,600,	$99,936 00
Five and a half per cent. on loans $1,838,422,	101,113 21
† Current expenses, being cost of repairs, salary of officers, lock tenders, wages, &c., average of 1837 and 1838,	121,246 82
	$322,296 03

Requiring 732,400 tons, at 50 cents per ton, to pay the same.

* See Schuylkill navigation company's reports, and Tanner's description of the canals and railroads of the United States, Philadelphia, Nov. 1834.

† There was also expended and charged to permanent improvements, during 1837 and 1838, the sum of $290,444 94, or $145,222 47 annually.

The maximum cost of the Reading railroad when finished, including land damages and purchases of property for wharves, depots, &c. will be four million dollars.

Capital stock,	$2,000,000 00
Loans in England at 5 per cent.,	2,000,000 00
	$4,000,000 00
And the annual cost will be 6 per cent. on capital stock, $2,000,000,	120,000 00
Five per cent. on loans, 2,000,000,	100,000 00
Current expenses, being for wear and tear of roads, repairs, salaries of officers, agents and hands engaged at depots and landings,	145,200 00
Annual expenses of an additional locomotive between Delaware and Schuylkill,	6,000 00
	$371,200 00

Requiring 732,400 tons at 50 cents per ton to pay the same.

In connection with this view of the subject it may be remarked, that the capacity of the canal is limited, while over the railway two millions of tons may be transported annually if required.

Annexed is a table, showing the diminished cost per ton for use of road, as the trade may increase, which will likewise apply to the Schuylkill navigation, to the extent of its ability, and the annual cost of either would not be further increased beyond a moderate per centage on the amount of increased tonnage.

TABLE.

	Dolls.		*Tons.*	*Per Ton.*
Annual road cost,	371,201	requiring	742,400	at 50 cents.
"	371,200	"	822,667	at 45 "
"	371,200	"	928,000	at 40 "
"	371,200	"	1060,555	at 35 "
"	371,200	"	1237,333	at 30 "
"	371,200	"	1484,800	at 25 "

READING RAILROAD.—NO. III.

In this number we will examine the cost, per ton, of freighting coal by the Schuylkill navigation, including cost of labor and wastage of coal in screening and shipping, &c., and also the cost per ton for motive power, use of cars, expense of shipping, &c., by the Reading railway.

A boat costing $550, is capable of carrying from 55 to 57 tons each trip, and would, were there no detentions other than the passing of the locks, be able to make twenty trips in the season of eight months, the time the canals are usually open—but owing to the occasional overflowings of the tow paths, by spring and fall freshets, and to the droughts of summer, the full average number of trips is 17, and the average load 54 14-20 tons, making in all an annual tonnage for each boat of 930 tons—average time of each trip up and down, two weeks. The annual expense of a boat will be as follows:

First cost of boat,	$550 00
Interest for first year, $550, at 6 per cent.,	33 00
Repairs,	00
	583 00

Deduct for 17 trips at $10 58 each trip,	179 86
	$403 14
Prior to commencing the second year's operations the boat will require caulking, &c., costing	$25 00
Interest for second year on $428 14,	25 69
	453 83
Deduct for 17 trips, at $10 58 each trip,	179 86
	273 97
Prior to the third year's operations, the boat will require repairs to the extent of	50 00
Interest for third year on $323 97,	19 44
	343 41
Deduct for 17 trips, at $10 58 each trip,	179 86
	163 55
Prior to the fourth year's operations, the boat will require repairs to the extent of	80 00
Interest for fourth year on $243 55,	14 61
	258 16
Deduct for 17 trips at $10 58 each trip,	179 86
	78 30
Prior to the fifth year's operations the boat will require repairs to the extent of	100 00
Interest for fifth year on $178 30,	10 70
	189 00
Deduct for 17 trips, at $10 58 each trip,	179 86
	$9 14

After the fifth year, the boat would cost as much to repair as it would earn; it may be said to be worn out, and is usually sold at from 10 to 25 dollars.

Annual cost of a boat $179 86, or for each trip,	$10 58
Captain's wages per trip,	10 00
Man's do. do.,	7 00
Boy's do. do.,	4 00
Food for captain, man and boy, per trip,	15 00
Food for horse,	4 80
Use of horse, and cost of towing lines,	3 50
24 ferriages (12 each way,)	1 38
Unloading of boat at wharves on Schuylkill,	5 00
Back toll on empty boat,	2 40
Total cost of freighting 54 14-20 tons,	$63 66

or one dollar sixteen and a half cents per ton.

The freights *actually paid* on the Schuylkill navigation averaged, in 1835, $1 19—in 1836, $1 50 1-2—in 1837, $1 27 1-4—and in 1838, $1 16—being an average for the last four years of $1 28 per ton.

The cost of transporting one ton of coal from the landings at Pottsville, and delivering it on board a vessel in the Schuylkill, per Schuylkill navigation, during the years 1835, 1836, 1837 and 1838, averaged $3 23 1-2, and was as follows:

Cost of labor at landings in Pottsville, including 5 cents per ton wastage, caused by passing the coal over screens into canal boats,	$0 12

Cost of labor at the wharves in Philadelphia, in

screening, wheeling and shipping, (including piling of one fourth of all the coal brought down,)	0 20
Loss of coal in handling as above,	0 17 1-2
Wharf rents, clerk hire, use of screens, &c.,	0 18
Toll,	0 92
Freight, average of 1835, 1836, 1837 and 1838,	1 28
Loss of coal, being difference between the Schuylkill navigation company's weight (by which the coal dealers pay for the coal, freight and toll) and the quantity actually delivered from the boats, estimated at	0 36
	$3 23 1-2

We now examine the cost, per ton, by the Reading railway from the same points at Pottsville, *where the coal, instead of being emptied from the cars into the canal boats, is carried in the same cars to the wharves on the river Delaware, and there discharged into the hold of the vessel.*

The power of a locomotive engine of 12 inch cylinder and 18 inch stroke, working under a pressure of from 70 to 80 pounds, and constructed with a view to *heavy transportation*, would be equal to the traction *on this road* of 200 tons nett at ten miles per hour.

An engine with her load will perform the trip from the coal region to Philadelphia [94 miles] *in one night*, and return in the next, making the performance of each engine one hundred and fifty trips *per annum*.

The annual cost of a locomotive and tender on this road will be as follows:

Engineer's salary, $60 per month,	$720 00
Fireman's pay, $36 per month,	432 00
Fuel, 4 tons of coal per trip, [up and down] or 600 tons *per annum*, at an average cost of $2 50 per ton,	1500 00
Oil, 2 gallons per trip, or 300 gallons *per annum*, at 90 cents per gallon,	270 00
Repairs and depreciation of engine and tender estimated at 25 per cent. on cost, $8000,	2000 00
	$4922 00

This amount divided by 30,000, the number of tons annually drawn by each engine, gives 16 2-5 cents per ton, as the cost of motive power.

But, as this may be considered the maximum power of a locomotive on this road, we also give a calculation based upon the minimum power of the engine, and adopt the latter in our estimates.

The annual cost of a locomotive engine, performing on this road one hundred trips annually [up and down], and drawing 150 tons nett at each trip, will be as follows:

Engineer's pay at $4 80 per trip,	480 00
Fireman's pay at $2 80 per trip,	280 00
Fuel, 4 tons of coal per trip [up and down], or 400 tons per annum, at an average of $2 50 per ton,	1000 00
Oil, 2 gallons per trip, or 200 gallons *per annum*, at 90 cents per gallon,	180 00
Repairs and depreciation of engine and tender, estimated for 100 trips, at 20 per cent. on cost, $8000,	1600 00
	$3540 00

This amount divided by 15,000, the number of tons annually drawn by each engine, gives 23 6-10 cents per ton as the cost of motive power.

A car with springs, costing $250, will be able to perform 125 trips up and down annually, with three tons each time, in all 375 tons, and the annual wear and tear, attendance and oil, will be as follows:

Proportion of wages for men attending the trains, five men being required to attend a train of fifty cars,	$25 00
Oil, 20 gallons *per annum* for each car, at 90 cents per gallon,	18 00
Repairs and depreciations, 25 per cent. on first cost, $250,	62 50
	$105 50

This amount divided by 375, the number of tons annually carried in each car, gives 28 1-4 cents per ton for use of cars.

Thus we have for cost of motive power per ton,	23 1-2
For use of cars,	28 1-4
To which is to be added for increased care in screening coal at mines, per ton,	12
Expense of discharging coal from cars into the vessels in the Delaware, including cost for detention of cars containing 1-10th of all coal brought down, clerk hire, wharf rent, &c.,	15
Total cost per ton of freighting and shipping by the Reading Railway,	$0 78 3-4
Total cost per ton of freighting and shipping [exclusive of toll] per Schuylkill Navigation,	2 31 1-2
Total cost per ton of freighting and shipping [exclusive of toll] per Reading railroad,	78 3-4
Difference per ton in favour of railway,	$1 52 3-4
To this must be added 10 cents per ton, being difference in freights coastwise in favor of receiving cargo on the delaware,	10
Total difference per ton in favor of the railway,	$1 62 3-4

READING RAILROAD.—NO. IV.

As regards the question, will the coal sustain injury while in the cars in passing on the railroad from Pottsville to this city? the experience of all the coal dealers so far as relates to railroad transportation, has been the same, whether the coal has passed while in the cars, over the railroads 1 mile, 3 miles, 5 miles, 10 miles, or 20 miles, to reach the Schuylkill navigation---that there is no sensible increase of dust or waste coal; and the conclusion of all with whom the writer has consulted (and they are many of the largest operators on the Schuylkill) is, that the injury to the coal arises chiefly from the loading and unloading, and not from the passage over the road in the cars.

Thus, it is evident, that if the same cars into which the coal is loaded at the mouth of the mines can be brougbt down to Philadelphia without any further loading or unloading, (the coal being carefully screened when put

NOTE—In the last annual report of the Schuylkill navigation company, there is an estimate of the loss of coal by waste, during the year 1838. It amounts to forty-one thousand five hundred and ten tons.

into the cars,) that all the loss arising from the present mixed means of transportation will be avoided---and this has been considered so great a desideratum, that in Scotland the following plan has been adopted:

It will be found in a work written by Thomas Graham (a friend to canals), and published in Glasgow, in 1836, he says:---

"I last Autumn suggested the plan and construction of a boat for carrying loaded railway wagons, and a boat of this description has now been completed. The Forth and Clyde canal connects the east and west of Scotland; about the middle of its course it is joined by the Monkland and Kirkintilloch railway, and receives from it large supplies of coal; which are unloaded from the railway wagons into the vessels navigating the canals, and conveyed by them coastwise to the various seaports of Britain and Ireland. Nothing is cheaper or more advantageous than this mode of transport, *so far as respects coasting vessels capable of entering the canal;* but there is a considerable disadvantage respecting the supply of coals to manufactories situated on or near to the banks of the canal; and also respecting the supply of coal to large sea vessels of many hundred tons burthen, which cannot enter the canal, but discharge their cargoes at the entrance of the canal into canal lighters, to be carried in these vessels through the canal. The coal brought along the railway, has in each of these cases, after being put on board a canal lighter and conveyed along the canal, the following disadvantage, viz: when brought to the point nearest to the manufactory where it is to be consumed, it must be unloaded from the lighter and laid on the canal banks---then loaded into a cart and carted to the manufactory. If the coals, on the other hand, is wanted for loading a sea vessel, which cannot enter the canal, then the lighter which has brought it from the railway goes out of the canal, and being laid along the high side of the sea vessel, the coal is lifted from the lighter and laid on the deck of the sea vessel, and thrown into the hold. The price of coal at Kirkintilloch, where the railway joins the canal, does not average four shillings per ton—the addition to this price, consequent on these *repeated loadings and unloadings*, is, therefore, considerable; and by the same operations *the coal is much broken and injured, and a considerable loss of value is incurred.*

"The wagon-boat completely obviates these disadvantages. The loaded railway wagons are run from the end of the railway directly upon the deck of the canal wagon boat, which is traversed by lines of rails for this purpose with the requisite turning plates. When the boat has got its full compliment of wagons on board, it is drawn to the point where the coal is to be delivered. In the case of a manufactory, by laying a few rails from the canal bank, the wagons are run from the deck of the boat to the manufactory where the coal is to be consumed, and the consumer thus receives the coal *in the same state that it came out of the mouth or opening of the coal mine.* When, on the other hand, the coal is to be loaded on board of a sea vessel, the canal wagon boat does not descend the lock which joins the canal to the sea, but remains on the level above the sea vessel; the wagons are then run from the deck of the wagon boat, and by means of a short railway are conveyed along the canal bank and wharves to the sea quay, where the large sea vessels are moored, *and the coals are at once discharged from the wagons into these sea vessels.* In this way the largest vessel has the same advantage and accommodation in receiving a loading of coal as the smallest lighter, and the *railway is thus in fact carried to every point of the canal.* The wagon boat now in use on the Forth and Clyde Canal, carries wagons with a load of nearly forty tons of coal."

How far the introduction of similar boats would answer upon a line of improvements such as the Schuylkill navigation, we may hereafter inquire.

Having in the former numbers examined the grades and length of this railway, and the lockage and length of the Schuylkill navigation; having also examined the annual cost of both these works, and shown the number of tons required by each, at a given rate of toll, to pay the same; having shown the total cost per ton for freighting and shipping by the Schuylkill navigation, and the same by railroad, upon the single article of coal, *which it may be said will be the* NIGHT *or* EXTRA *business of the road*, leaving it the full day to perform its transport of passengers and goods---- before showing the large revenue to be derived from these last named sources [which we postpone to another number,] we will show the exact correspondence of the charges for motive power, as stated by us, when compared with the Stockton and Darlington railroad, *used almost exclusively for the transportation of coal.*

The length of the Stockton and Darlington railway, or rather of that part of it on which locomotives are used, is twenty miles, and the grade of the same is descending from the mines, varying from about 3 feet to 50 feet per mile.

The load of the locomotive is limited to its power to bring back the empty cars up the grades. The descending load is composed of 63 1-2 tons of coal in 24 cars weighing 31 tons, in all 94 1-2 tons; the ascending load is the 24 empty cars weighing 31 tons. The engines perform two trips up and down daily, or 80 miles. The Directors of the Stockton and Darlington railroad have entered into a contract with three responsible persons to supply the motive power. The company pay them 4-10 of a penny, or 7 1-2 mills, per ton per mile for coal carried down, and there is no charge for bringing back the empty cars. For this price the contractors keep the engines in complete repair, furnish workmen and materials, and pay all the current expenses of haulage; such as engineer's and fireman's salaries, fuel, oil, &c., besides an interest of 5 per cent. to the company on the value of the engines and workshops used by them.

On the Stockton and Darlington railway the engines never go off but with full loads; and were the grades of that road similar to those of the Reading railroad, the power of the same engines would be equal to bringing back 72 empty cars, weighing 93 tons, and the descending load would comprise 190 1-2 tons of coal and 72 cars, weighing 93 tons; in all 283 1-2 tons----and the charge per ton per mile would be 2 1-2 mills instead of 7 1-2 mills as above; or for 94 miles, the length of the Reading railroad 23 1-2 cents per ton, being exactly the same cost as estimated in No. III. The price of labor, iron, &c., for the engines used on the Stockton and Darlington railway may be estimated at 20 per cent. less on the Reading railway; but this is counterbalanced by the engines on the Reading railroad performing a trip of 94 miles nightly, while on the other the engines are obliged to be attached to, and detached from, the trains four times daily, and perform only eighty miles per day.

On the Liverpool and Manchester railway, during the year ending June 30, 1834, the quantity of passengers carried over the road was, in tons, 39,420, and the gross receipts therefor, 105,456*l.* 3*s.* 10*d.*, or 2*l.* 12*s.* 6*d.* per ton of passengers. The quantity of merchandize carried during the same period, was 202,603 tons, and the gross receipts [less amounts paid for cartage in Manchester and Liverpool] were 74,883*l.* 11*s.* 11*d.*, or 7 shillings and 4 3-4 pence per ton, and the quantity of coals carried an average distance of 15 miles was 86,173 tons, and the gross receipts therefor 5,517*l.* 2*s.* 5*d.* or 15 1-4 pence per ton for 15 miles,* *being 1 cent and 9 mills per ton per mile for motive power, use of cars, and tolls.*

*In the Report of the Liverpool and Manchester railway Company, for the six months

Annexed, is the opinion and guarantee of Mr. William Norris, of our city, most favorably known in Europe as well as in this country as a builder of locomotives, showing the power of his engines on the Reading railway.

PHILADELPHIA, February 26, 1839.

DEAR SIR:---In reply to your request for information, as to the capability of my locomotives in their performances on the Reading railroad, I have the pleasure of stating, that my class B [the same size as those in daily use on the Philadelphia and Baltimore, and the Baltimore and Washington, and various other roads] can, with *every facility*, do the following duty *per annum:*

One hundred and fifty trips from the coal region to Philadelphia, each trip with a load of 200 tons of coal in 67 cars, making a gross load, with weight of cars, of about 290 tons, to be performed in all cases within *ten* hours. The engine returning in the same time, from Philadelphia to the coal region with the 67 cars in one train.

The annual cost for maintaining one locomotive and tender, will not exceed the following, viz:

Salary of engine man and fireman.	1,200
600 tons of coal at $2 50,	1,500
Oil,	300
Repairs and depreciation of engine and tender,	2,000
	$5,000

Thus showing, that one of my locomotives of class B can, at a cost of $5,000 *per annum* [all charges included] transport from Pottsville to Philadelphia, 30,000 tons of coal *per annum*, which will give but 16 2-3 cents, as cost of motive power, per ton, for the whole line of 94 miles, including the taking back of the empty cars.

I am so well assured of the above facts, from the performances of my machines, during the last three years, that I will guarantee all I have said above, provided I have the selection and charge of the engine men.

Yours, very respectfully,

WILLIAM NORRIS.

(To be continued.)

HARLEM RAILROAD RECEIPTS.

In May,	1838,	$7,937 62	In 1839,		$9,663 96
June,	"	8,897 59	"		11,911 99
July,	"	11,240 76	"		12,001 22
Aug.,	"	9,969 23	"		12,626 74
To 23d Sept.,	"	6,739 90	"		9,867 66
		$44,785 10			$56,071 57

Showing an increase over the same period of last year of $11,286 47, in only 4 months and 22 days, and these receipts are at the rate of $141,-164 00 per annum.

The total expenses of every sort and kind are $75,000 per annum, and the interest on their debt $21,000---together, $96,000 per annum; leaving the balance of its receipts, whatever they may be, for a dividend.—*Gaz.*

ending June 30, 1832, which is more in detail than the subsequent ones, it will be found that there was carried on this road (from the mines chiefly to Liverpool, thereby avoiding the heavy grades) 22,045 tons of coal in 234 trips, being about 94 tons each trip. Of merchandize there was carried 72,601 tons in 2,248 trips, or about 32 tons each trip; and there was carried 174,122 passengers, equal to 17,212 tons, in 2,636 trips, or 6 1-2 tons each trip. The total number of trips was 5,118, and the total tonnage 111,858 tons, being an average of 22 tons nett each trip, or, including cars and carriages, about 32 tons gross load.

Table of the mean temperature of each of the months for the years of 1833, 1834, 1835, 1836, 1837, and 1838. Also the day the thermometer was at the *extreme* lowest and highest; and the number of days that was clear, cloudy, rainy, white frost, foggy morning, snow, hail, or sleet, in each month. From the meteorological record kept at Avoylle Ferry, on Red river, Louisiana. Lat. 31° 10″ north, lon. 91° 59″ west, nearly. By P. G. VOORHIES.

DATE.		Mean temp. of months.				Thermometer, the extreme in each month.					Number of days in each month that was either						
		Morn	Noon	Night	of the m'nth	DAY.		lowest	DATE.		high't	Clear	Cl'dy	Rainy	white frost.	foggy morn.	Snow	hail or sleet
JANUARY	1833	51	62	60	57	JANUARY	18th	30	JANUARY	30th	72	19	12	4	1	2		
	1834	44	51	49	48	"	5	16	"	11	76	4	27	19	1	1	3	
	1835	45	60	56	54	"	6	29	"	26	86	19	12	10	4			
	1836	46	59	58	54	"	28	26	"	16	74	19	12	9	6			
	1837	39	53	46	46	"	15	24	"	18	70	20	11	6	9	2	1	
	1838	46	54	51	52	"	12	24	"	16	76	18	13	9	1			
FEBRUARY	1833	49	60	58	56	FEBRUARY	8th	37	FEBRUARY	28th	75	13	15	6	1			
	1834	51	66	67	60	"	2	31	"	22	78	15	13	5	4	1		
	1835	37	51	50	46	"	8	12	"	21	74	19	9	6	8	1	1	1
	1836	48	63	56	56	"	2	30	"	21	74	15	14	7	5	1		
	1837	44	58	55	52	"	18	29	"	15	70	14	14	7	5	1		
	1838	35	47	44	42	"	16	12	"	25	68	15	13	5	9	1		
MARCH	1833	51	63	59	57	MARCH	2d	28	MARCH	19th	73	12	19	12	1			
	1834	55	67	63	62	"	1	37	"	25	80	11	20	9	2	2		
	1835	48	64	60	57	"	1	30	"	31	80	15	16	7	4		1	1
	1836	50	63	58	57	"	3	32	"	16	80	19	12	6	5			
	1837	52	63	60	58	"	15	38	"	28	78	15	16	9	2			
	1838	54	68	62	61	"	8	32	"	31	83	20	11	4	4			
APRIL	1833	61	75	68	68	APRIL	18th	52	APRIL	23d	85	18	12	4		1		
	1834	60	74	69	67	"	7	48	"	30	84	20	10	10		5		
	1835	56	70	65	64	"	6	43	"	23	80	17	13	7		3		
	1836	63	74	69	69	"	22	53	"	26	82	22	8	8				
	1837	57	68	64	63	"	8	38	"	29	80	18	12	8				
	1838	65	77	68	70	"	18	51	"	27	84	22	8	6				
MAY	1833	69	80	74	74	MAY	5th	63	MAY	27th	87	15	16	14				
	1834	65	77	74	70	"	8	50	"	28	88	19	12	6				
	1835	68	80	76	75	"	2	58	"	30	86	28	3	3				
	1836	68	78	73	72	"	28	58	"	30	86	17	14	10				
	1837	64	81	72	72	"	16	51	"	30	86	22	9	6				
	1838	63	73	68	69	"	24	50	"	14	85	20	11	9				

(To be continued.)

A writer in the Boston Atlas, maintains, with great force of argument that a low rate of fare on railroads is the best for the stockholders as well as for the public. The eastern railroad, from Boston to Salem, commenced operations with a low rate of fare, and the consequence is, it is doing better than any other railroad in Massachusetts. It is earning ten per cent, per annum. It is said to carry more passengers into Boston than all other railroads which come into the city.

The Boston and Worcester railroad is also mentioned in illustration of the position of the writer. At about the commencement of the present year the fare of this road was reduced from $2 to $1 50, and since the reduction, the nett income of the road has been greater than it was before.

It is stated that a train of cars can be run for $1 per mile; and of course it would cost but little more to carry 200 passengers than it would 50. Hence by reducing the fare, the number of passengers be increased to a degree greater than the degree of reduction in fare, most certainly the proprietors of a road are gainers by the change.

The public will travel vastly more if the rate of fare be low, than if it be high. If a man could go to Boston from a given place for $2, he would be likely to go twice; when if it cost him $3, would go but once.